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The Survival of Portuguese Credit Co-operatives: An Econometric Approach

Paula Cabo[1] and João Rebelo[2]

Abstract

The banking system robustness is an actual concern and a priority for EU and national authorities. Although Portuguese Agricultural Credit Co-operatives (CCAM) performance, as a group, compares favourably with that of other credit institutions, individual CCAM occasionally do enter in distress. The increasingly large size of the CCAM raises concerns regarding the resolution of potential distress situations given some of the cooperative governance rules. The main purpose of this paper is to evaluate CCAM risk of insolvency. To accomplish this objective, the authors analyze the CCAM failures in the period between 1995 and 2009, adopting a Cox proportional hazards model. The model shows that Transformation ratio and Other Structural Costs ratio were important indicators to evaluate the relative risk of insolvency for CCAM.

Keywords: credit co-operatives, solvency, Cox proportional hazards model

[1]Assistent, Department of Social Sciences, Agrarian School; Polytechnic Institute of Bragança (IPB) and CIMO, Campus de Santa Apolónia, apartado 172, 5301-855 Bragança, Portugal, E-mail: paulacabo@ipb.pt (corresponding author)

[2]Full Professor, Department of Economics, Sociology and Management (DESG) and CETRAD, University of Trás-os-Montes and Alto Douro (UTAD), Av. Almeida Lucena, 1, 5000 – 911 Vila Real, Portugal, E-mail: jrebelo@utad.pt

1. Introduction

The banking system robustness is an actual concern and a priority for EU and national authorities, due of its importance to the real economy and social confidence. There is a consensus that the key for prevention lays on a regulation improvement, including a set of creation requirements and the enforcement of prudential rules on the daily operations, and enhance supervision, monitoring the execution of those rules and requirements.

Meanwhile, an effective supervision requires a constant process of inquiring and analysis of data and banking activity, consequence of the increasing velocity of financial innovations, the lap time to engage in fraud or simply mismanagement and the difficulty to detect bad practices. The direct costs and scary of resources make the inspections *on-site* prohibitive and subject to a restricted implementation. A healthy financial institution examined too often waste valuable resources; but if a problematic institution is not examined with the adequate frequency, the delayed will raise the resolution costs (Rocha, 1999).

Although actual, banking system robustness is not of recent interest for researchers. To evaluate the banks financial healthy and determine the urgency of inspections *on-site* several models of prediction of failure were formulated. Those models offer regulators an early warning system that statistically discriminate problematic and healthy banks based on a selection of financial indicators. This system allows a better allocation of bank examining resources, helping regulators to detect institutions in financial distress before is too late. Different techniques were used to construct prediction of failure models, protruding discriminant analysis, *logit* and *probit* models. The aim of these models is determine the probability of a bank with specific characteristics fail. However, the predicted probabilities are of failure and not failure in a certain (not specified) point in time during a definite time period. The same as the techniques mentioned above, the Cox proportional hazards model provides information regarding the expected time of failure. This model generates a survival profile for banks, i. e., the probability of bank survive over a different specified time periods as a function of time.

The recent financial crisis and subsequent economic recession highlight the strengths of co-operative banks (The Economist, January, 23th 2010: 66), but also their weaknesses. To the Portuguese case, there is no doubt that the improvement of co-operative banking performance is a strategic and operational matter to ensure the economic and financial survival of Agricultural Credit Co-operatives, CCAM (Caixas de Crédito Agrícola Mútuo). Although Crédito Agrícola performance compares favourably with that of other credit institutions, individual CCAM occasionally do enter in distress as illustrated by history. The increasingly large size of the CCAM raises concerns regarding the resolution of potential distress situations given some of the cooperative governance rules.

In particular, the restrictions on control rights and residual claims linked to the cooperative governance framework limits the range of options for resolving systemically important CCAM as it makes raising capital more difficult for these organizations. Vaguely defined ownership rights combined with restricted voting rights might prevent raising capital from existing and new members, particularly at time of distress when large investors are more likely to provide capital injections. In the past, resolution of CCAM typically involved the merge or incorporation of the weak CCAM by another CCAM (Cabo and Rebelo, 2005). However, this resolution mechanism is more difficult to apply to a large systemic CCAM. Also, CCAM regional orientation can be a strong constraint to find another CCAM able to absorb it, without losing their territorial identity.

As a system, in the process of strategic planning, more specifically, in the phase of diagnosis and subsequent adoption of plausible prescriptions by the main stakeholders (members, board of directors, regulation and supervision entities) is important to know something about the survival of the units that integrate the system. In other words, is important to know the probability that a CCAM with a given set of characteristics will survive longer than some specified length of time into the future, and which are the characteristics that most contributed to the CCAM insolvency. The achievement of this objective requires the use of some sort of statistical model, a “survival model”, to translate CCAM characteristics into estimates of risk.

The main purpose of this paper is to identify “problematic” CCAM and to evaluate their risk of insolvency as a function of financial indicators, providing CCAM stakeholders with a tool to predict bankruptcies with sufficient lead time to institute remedial action at these cooperatives. To accomplish this objective, the paper analyzes CCAM failures in the period between 1995 and 2009 and adopts a Cox proportional hazards model that calculates the proportional risk of insolvency as a function of financial/economical indicators.

Besides this Introduction, the paper contains six sections. Section 2 includes a brief description of the cooperative banking system in Portugal; Section 3 presents the Cox proportional hazards model; Section 4 includes the variables, sample and data. The results from this model are presented in Section 5. And, Section 6 contains the conclusion and suggestions for further research.

2. The Cooperative Banking System in Portugal

The Cooperative Banking System in Portugal comprises only agricultural credit cooperatives. Its genesis goes back to the XVI century, to an institution called Common Barns, allowing farmers to keep stocks and seek financing. However, until 1976, the Portuguese agricultural credit cooperatives (CCAM) played a minor role in Portuguese banking activity, with a share of only 1% of total deposits and credit. Following the 1974 political changes and the country entrance to the European Union (EU), in 1986, CCAM were considered in the framework of a financing strategy for the development of the agricultural sector. So, during the eighties of last century the CCAM activity experienced a spectacular growth in their activity. This period, characterized by initial euphoria and disorganization, ends by the creation, in 1992, of a financial group, the Credito Agrícola group and the start of a concentration process in order to create stronger local structures by merging small local CCAM within the same region. Starting off with 220 local CCAM in the 1990s, it reaches 91 in 2009.

The Portuguese Caixas de Crédito Agrícola Mútuo (CCAM) are local cooperative credit institutions, which capital is subscribed by their members, individuals and companies, linked to Primary Sector activities. CCAM are specialized in lending to agriculture and related industries, but bank with any customer type.

Fulfilling is mission of "…*contributing to the development of Local Communities*." (Crédito Agrícola, 2010), CCAM perform a crucial role in boosting local and regional socio-economic development, promoting social and territorial inclusion, by serving the lower social status and operating in impoverished regions[1], and providing opportunities for qualified jobs.

In the present scenario of increasing rural population exodus to big urban centres, private enterprise sector delocalizes and State rationalizes and closes public services in rural areas. CCAM stay and in many places they have a social function as well as a financial purpose.

Presently, the Credito Agrícola is one of the main financial national groups (Table 1), having a significant position in the Portuguese banking system, namely, regarding employment, branches network and total deposits. A structural analysis shows that Crédito Agrícola has a high dependency of costumers' deposits and presents one of the sector best levels of capitalization.

[1] Crédito Agrícola market segment is inland and low income individuals. In terms of geographic distribution, over half of CCAM costumers (53.3%) live in the country's inland regions. Its distribution across the regions means is present in many places where the economic strength has been sapped. Because of this, it has a very high proportion of costumers (more than 90%) on low and moderate incomes (Crédito Agrícola, 2008). CCAM have to be able to adjust to the real needs of its costumers.

Table 1 - The Biggest Portuguese Banks, by December 2008

(Figures in EUR million and activity for Portugal only)

	CGD		BCP		BES		BPI		CA	
	Values	Market Share	Values	Market Share	Values	Market Share	Values	Market Share	Values	Market Share
Employment (n.º)	9.747	17.00%	10.687	18.64%	7.942	13.75%	n.a.	__	3.858	6.73%
Branches (n.º)	832	13.29%	918	14.66%	743	11.87%	n.a	__	673	10.75%
Net Assets	111,060	23.29%	94,424	19.80%	75,187	15.77%	39,963	8.38%	11,447	2.40%
Equity	5484	20.83%	8559	32.52%	4653	17.68%	1315	5.00%	979	3.72%
Net Profit	459	13.34%	201	5.84%	403	11.71%	360	10.46%	121	3.52%
Net Loans	77,432	24.09%	72,372	22.51%	45,901	14.28%	27,941	8.69%	7,188	2.24%
Total Deposits	60,128	27.60%	66,264	30.41%	26,387	12.11%	19,002	8.72%	9,158	4.20%

Note: n. a. – not available; Market share in percentage.

Source: Authors' calculation based on company annual reports; Bank of Portugal and Portuguese Banking Association websites.

Additionally, comparing the Group performance with other relevant national banks (Table 2), Crédito Agrícola presents an excellent position regarding efficiency, solvency, liquidity, and customers claims.

Table 2 – Crédito Agrícola Position, by December 2009

Performance Indicators	**Values**	**Ranking**
Transformation Ratio*	87.0%	1st
Efficiency Ratio**	49.8%	2nd
Return on Assets (ROA)***	1.0%	2nd
Return on Equity (ROE)****	12.2%	4th
Solvency Tier 1 Ratio******	12.0%	1st
Costumer claims:		
Deposits: claims *per* 1000 accounts	0.06	1st
Housing credit: claims *per* 1000 contracts	0.89	2nd
Checks: claims *per* 10,000 checks processed	0.06	1st

Source: Crédito Agrícola (2010); Banco de Portugal (2010)

* Net Loans / Deposits; ** Structural Costs / Net Worth [Structural costs include amortisation + general administrative expenses + staff costs; Net Worth include financial margin + net commissions + other income (including results from financial operations)] *** Net Profit/ Average Net Assets; **** Net Profit / Equity; ***** Basic Own Funds / Weighted Risks (assets + off-balance-sheet items)

Except for banking operations, the CCAM are ruled by following the traditional cooperative principles, namely, open membership, democratic control and restricted residual claims. The dual nature of credit cooperative is reflected by their formal and institutional solutions.

The agricultural credit cooperative system in Portugal is made up of an integrated system (SICAM) of two types of cooperatives: the central and the singles (associated) in a regime of co-responsibility. SICAM = Central CCAM + Associated CCAM (91 local CCAM).

Altogether, they have 681 domestic branches in mainland Portugal and the Azores Islands, plus the 2 Offshore branches in Funchal and Praia.

CCAM have freedom of association with the Central CCAM and they can operate outside SICAM, although the rules for this are more stringent and approximate more to those that prevail in other credit institutions. Currently, only five CCAM remain outside SICAM.

The Central CCAM role has no parallel in the remaining financial institutions. Central CCAM is a financial institution under the cooperative form, offering a full service bank, competing in equal terms with the largest banks operating in Portugal. Being the main institution of the SICAM, Central CCAM represents the Crédito Agrícola Group domestic and internationally and is the top responsible and guardian for the running of the whole CCAM system, empowered by Bank of Portugal with supervision, orientation and monitoring competences over the associated CCAM.

Considering SICAM specificities, the high degree of local CCAM autonomy, the organizational structure results in a governance model shared between the Central CCAM and the associated CCAM.

As financial institutions, CCAM face the risks of the country's financial system. The ability to efficiently manage financial risk will determine a CCAM's survival in the competitive market. If the single CCAM, let alone the central CCAM, is structured to fail, the entire network can be prejudiced. It is therefore important that mechanisms are available to help identify high-risk CCAM with accuracy and within a reasonable time-frame. This identification can be made using financial ratios. The Cox Proportional Hazards Model is a powerful tool to assess the solvency of CCAM.

3. The Cox Proportional Hazards Model

The Cox Proportional Hazards Model has been used to help in the financial evaluation of banks, providing an early warning tool to predict failure and assisting decision makers when they are allocating resources (Braga *et al.*, 2006).

The Cox proportional hazards model presents three main advantages over other risk modeling techniques, such as discriminant analysis and the Logit/Probit model: it can be used to generate the probable time to failure; it does not require to set assumptions about the data's distributional properties, and results from the Cox model are considerably more significant than results from the two noted alternative models (Whalen, 1991). Several authors compared Logit and hazards models in their ability to predict the insolvency and conclude that hazards models are superior (Lee and Urrutia 1996; Janot, 2001).

The Cox model (Cox, 1972) can be described in the following form [as in Rocha (1999), Janot (2001), Martins (2003) and Braga *et al* (2006)]. T is the time to insolvency of a firm, and S(t), the survival function, is the probability that the firm will be solvent longer than t time period, with S(t) defined by

$$S(t) = \Pr[T > t] = 1 - F(t) \qquad (1)$$

where F(t) is the cumulative distribution function of the time to failure. The probability density function of t is $f(t) = -S'(t)$. The insolvency time distribution can be represented by F(t) or f(t), and is described by the hazard function[2]:

$$h(t) = \lim_{dt \to 0} \frac{P[t < T < t + dt \mid T > t]}{dt} = \frac{-S'(t)}{S(t)} \qquad (2)$$

The hazard function, h(t), is used to calculate the probability of insolvency in the next time period, given that the firm survives up to time t. According to Cox and Oakes, (1984), there are statistical advantages to be gained by using estimate h(t) as opposed to F(t) or f(t). After the estimation of h(t), the F(t) and f(t) estimates are obtained by

$$F(t) = 1 - \exp\left[-\int_0^1 h(u)d(u)\right] \qquad (3)$$

and $$f(t) = F'(t) \qquad (4)$$

$\int_0^1 h(u)d(u)$ is the integrated hazard function. It has no immediate interpretation but is a basic tool used to test model variables for aptness.

There are different types of hazard models, settled in accord with the nature of the insolvency time distribution hypothesis. The proportional hazards model assumes the form:

$$h(t \mid X, \beta) = h_0(t) g(X, \beta) \qquad (5)$$

Where, on the left side of the equation, $h(t \mid X, \beta)$ is the hazard function of a firm in time *t*; X is a collection of variables that is considered to affect the likelihood of insolvency; and β is the coefficient that describe how the variable affects the insolvency probability and will be estimated. On the equation's right side, $h_0(t)$ and $g(X, \beta)$, are, respectively, nonparametric and parametric parts. The nonparametric function is the baseline hazard probability and depends only on time. If explanatory variables were centralized so that a firm with X= 0 has the same ratio values as the mean of the population, then $h_0(t)$ is the hazard function for an

[2] The survival function, the density probability function and the hazard function are mathematically equivalent, so, if a function is given, the other can be derived.

'average' firm in the population. In a proportional hazards model the explanatory variables effect is calculated multiplying the hazard function of the average firm, $h_0(t)$, by a function $g(X,\beta)$ of the explanatory variables deviations from its average values.

In the Cox Proportional Hazards Model $g(X,\beta)=\exp(X'\beta)$ and hazard function is represented by:

$$h(t \mid X,\beta)=h_0(t)\exp(X'\beta) \qquad (6)$$

To determine the probability that a firm will survive longer than some given time into the future, the related survival function is given by

$$S(t \mid X,\beta)=S_0(t)^{\exp(X'\beta)} \qquad (7)$$

where

$$S_0(t)=\exp\left[-\int_0^1 h_0(u)d(u)\right] \qquad (8)$$

is the baseline survival function corresponding to the baseline hazard function $h_0(t)$.

For estimate the model, samples of solvent and insolvent CCAM are needed and the time period before insolvency must be defined for both samples. Using this information, the baseline probability can be obtained; and with the estimated coefficients, the survival function can be determined by substituting coefficients of the relevant variables into equation (8).

The insolvency event has been studied by several authors, searching for indications of its possible occurrence in way that the organizations can be adequately structuralized, reducing the possibility of bankruptcy. However, there is not a consensus regarding the definition of the insolvency or the adequate methodology for the construction of insolvency prediction models. To Emery and Finnerty (1997), insolvency occurs when a firm is not able to pay its debts. Altman (1968) considers that firm insolvency occurs when the shareholders receive profitability lower than alternatives supplied by the market under similar conditions. And Matias and Siqueira (1996) classified a bank as insolvent if it was under intervention or liquidation by the supervising entity. Similarly, Janot (2001) considers that a firm becomes insolvent when presents negative equity or if it's impossible to continue operating without incurring into losses that would result in negative equity. This author also defines insolvency when an institution is placed under evidence by the supervising authorities. He concluded that the identification of a financial institution as a likely candidate for failure by bank regulatory agencies is a signal of insolvency.

The literature treats the factors that contribute for a firm insolvency under distinct perspectives. Regarding banks, literature signs the influence of the macroeconomic aspects, and frauds, management imprudence and consecutive losses (Fully-Bressan, 2002). Gimenes (1998) pointed external causes, as strong fall of demand, economic recession, governmental politics and radical and significant social changes; and internal causes, as management inefficacy and inadequate business strategy, inefficient productive system, extreme indebtedness, among others.

Several authors use financial indicators to evaluate the firm risk of insolvency or bankruptcy. The first study on insolvency prediction was published in 1932 (Patrick, 1932 *apud* Kanitz, 1978), where the data of 19 companies that declared insolvent between 1920 and 1929 was compared with others 19 companies well-succeeded. However the subject only flourishes in the 1070s with the use of statistical techniques; outstanding the Altman (1968) study, using the first widely spread technique to study insolvency: the Discriminant "Z-score" Model, still currently used in many European Central Banks.

In the last decades several studies have been made on the subject, especially regarding bank failure (Matias and Siqueira, 1996; Rocha, 1999; Janot, 2001; Martins, 2003) but cooperative banks have been neglected. The works of Fully-Bressan (2002) and Braga *et al.* (2206) regarding Brazilian credit cooperative are the few exceptions. Table 3, in next page, offers a brief review of the findings of these studies.

4. The CCAM: variables, sample and data

As referred in section 2, the SICAM establishes a regime of co-responsibility between Caixa Central and its associates. Central CCAM guarantees the associates without limitations and is also guaranteed by them. SICAM is, by this way, subordinated to a double guardianship. On the other hand, when a CCAM gets into financial distress, the Central CCAM have an incentive to protect this CCAM from default because is important to maintain the whole CCAM system with high reputation and confidence to the different stakeholders (depositors, loaners, Bank of Portugal ...).

Thus, is not usual to see a CCAM bankruptcy. Indeed, although 28% of the 190 CCAM associated to SICAM in 1995 presented negative equity, over the period of our analysis (1995-2009), only 5 CCAM went bankrupted with their assets transferred to other CCAM. And between the 5 bankrupted only one belongs to the 28% group.

Within SICAM management control are often exercised by Central CCAM that operates the orientation and supervision function and therefore, is the first to find out managerial failures.

Table 3 – Summary of Insolvency Relevant Financial Indicators

Authors	Relevant Financial Indicators
Altman (1968)	- Current Assets - Current Liabilities / Total Assets - Retained Profits / Total Assets - Profits before Interests and Taxes / Total Assets - Equity Market Value /Total Liabilities - Sales / Total Assets
Kanitz (1978)	- Net Profit / Net Assets - Current and long run Assets / Total liabilities - Suppliers / Total Assets - Current Assets / Current Liabilities - Operational profit / Gross profit - Cash and equivalents / Total Assets
Matias and Siqueira (1996)	- Administrative Costs - Equity / Credit in liquidation - Total Revenue Growth
Rocha (1999)	- Financial Margin
Fully-Bressan (2002)	- General Liquidity= Current and long run Assets / Current and long run Liability - Short-term Liquidity= Cash and equivalents/ Short term Deposits - Personnel fees = Labour Costs to Total Revenue
Martins (2003)	- Banking Loans / Current Assets - Return on Assets
Braga *et al*. (2006)	- Liquidity = Current and long run Assets to Current and long run / Liability - Salary and benefit expense / Total Revenue - Total Loans / Equity

In cases of coarse management failure or fraud, the management can be formally dismissed by the Central CCAM, under its supervision and intervention[3] powers. Long-term inefficiencies can be solved through obligated[4] mergers with more efficient CCAM.

Additionally, contrary to the remain financial institutions Deposit Insurance Fund, the Insurance Fund of Agricultural Cooperative Credit (FGCAM) besides secure the CCAM costumer deposits, performs an active role in the SICAM economic and financial restructuring process, as part of its task to promote SICAM solvency and liquidity. Rescuing

[3] Central CCAM is empowered to intervene in the associates, by the assignment of a representative to track CCAM management or nomination of provisory directors. When it verifies a disequilibrium situation that, because its extension or continuity, can jeopardize the CCAM daily running, its solvency is at risk or serious irregularities occur. Plus, when the associated is in serious financial disequilibrium, or in risk of being, and unfollow Central CCAM guidelines, Central CCAM can dismiss total or partly of the associated management and supervision boards and assign provisory directors to them. Interventions have up to one year of lifetime, after that it can be renewed.

[4] Although mergers are friendly (they must be approved by the general meeting) the influence of Central CCAM is considerable, being this top institution the trigger and even the one that choose the merger partners (Cabo and Rebelo, 2005).

operations FGCAM under the form of subordinated loans are conditioned to an economic and financial restructuring process, often including the CCAM incorporation in another CCAM.

Because of this small number of CCAM that went bankrupt as defined, it was necessary to refine the definition of 'insolvent'. Thus, a CCAM will be considered potential insolvent if: (a) present negative equity; (b) were subjected to a Central CCAM (or FGCAM) intervention; (c) were incorporated in another CCAM and follow-on a FGCAM loan and (d) present bankruptcy by any reason. In this way, CCAM that in the study's period have not been a target in merger operations or subjected to a Central CCAM (or FGCAM) intervention are classified as solvent CCAM.

As mentioned earlier, SICAM is experiencing of a profound restructuring era. The purpose is CCAM consolidation. According to a SICAM leader, mergers between CCAM, generate synergies and allow the creation of structures of internal control. Starting off with 220 local CCAM in the 1990s it reaches 91 in 2009. And the process will carry on until reach the ideal number of 70 CCAM (Portal da Serra: 21st November 2006)

During the study's period from initial 190 CCAM: 4 bankrupted; 100 merged or went incorporated in another CCAM; 89 benefit from FGCAM subordinated loans, Central CCAM intervened in 55 CCAM and following Central CCAM intervention, 40 CCAM merged or went incorporated in another CCAM. Table 4 includes the explanatory variables used in the current research. The variables selection was inspired on the authors' previous studies on CCAM and from the literature review of insolvency.

Table 4 – Variable definitions and transformations

Group 1 - Credit risk management ratios	Group 2 – Solvency ratios
1. Transformation ratio = Loans / Deposits 2. Credit overdue = Credit overdue / Gross Credit 3. Credit overdue provision = Specific provisions / Overdue Credit	1. Liquidity = Net cash and equivalent in Central Banks and other credit institutions / Total assets 2. Debt to Equity ratio = Total liabilities / Equity 3. Indebtedness = Total Debt / Total assets
Group 3- Cost and expense ratios	**Group 4 – Return ratios**
1. Labours costs = Salary and benefit expenses / Total assets 2. Other structural costs = Other administrative expenses* / Total assets 3. Expenses ratio =Total expense / Total revenue	1. ROC = Net Profit / Shareholders Capital** 2. ROA = Net Profit / Total assets 3. Financial margin = Financial margin / Total assets

* Costs of general services incurred in controlling and directing an organization, such as accounting, energy and water supply, advertising, office resources expenses, etc. . * *The option for Shareholders Capital instead of Equity is justified by the existence of CCAM with lower equity resulting from previous years accumulated losses that can jeopardise the study results.

Data in our study are from fifteen year balance sheets of 190 CCAM associated to SICAM from December 1995 to December 2009. The 52 CCAM that present negative equity in December 1995 and 3 CCAM that went out SICAM during the study's period were excluded from the sample. The first ones, because, by the study criteria, they were classified as insolvents, with a negative time to fail (T) which violates the Cox model assumption that T must be positive. The seconds, the data available does not cover the entire period of the study. From the remaining 136 CCAM, ⅔ of them (92 CCAM) were randomly selected to constitute our sample. According to the study's criteria, 52 of the sampled CCAM were grouped as solvent and 40 were grouped as insolvent (Table 5).

Table 5 – Insolvency classification in the sample

	Number of insolvent CCAM	%
Dec. - 1996	2	5
Dec. - 1997	5	12.5
Dec. - 1998	6	15
Dec. - 1999	5	12.5
Dec. - 2000	3	7.5
Dec. - 2001	1	2.5
Dec. - 2002	3	7.5
Dec. - 2003	4	10
Dec. - 2004	4	10
Dec. - 2005	0	0
Dec. - 2006	1	2.5
Dec. - 2007	4	10
Dec. - 2008	1	2.5
Dec. - 2009	1	2.5
Total	40	100.0

Summing up, the sample consists of data from CCAM whose time until insolvency (failure) is known and from solvent cooperatives that had not failed through to December 2009, the end of the period of analysis. The data from CCAM that had not failed during the study period are said to be censored. The 15 years study's period is the censored survival time, once we only can state that CCAM survive at least that time in the future. The possibility of censoring the solvency time is another advantage of the proportional hazards model (Janot, 2001). The statistical procedures were implemented using SPSS software.

For a solvent cooperative, the censored survival time is defined to be the time (in years) from December 1995 until the date of insolvency of its matched insolvent cooperative. Survival time for an insolvent cooperative is defined to be the time (in years) from December 1995 until the date of its insolvency (Table 5).

Table A in annex offers the variables summary statistics for the year 1995. Comparing the information between groups, we can observe that, on average, regarding credit and risk management ratios, insolvent CCAM present higher Transformation ratio and Credit Overdue but minor Credit Provision ratio. Concerning the solvency ratios, insolvent CCAM, on average, present a minor Liquidity and Debt to Equity ratio and higher Indebtedness. In the cost and expenses ratio group, insolvent CCAM present a worst performance regarding Labour Costs and Other Administrative Costs. Expenses ratio is higher for solvent CCAM. Insolvent CCAM also present, on average, higher return ratios. This data show data insolvent CCAM are neglecting costs and maximising revenues. Insolvent CCAM leaders are less risk aversion than their pairs. They are engaging in a less cautious, more risk taken business strategy, far away from the typical strategy of the cooperative credit: "dull but safe". Time seems to teach us that in the long run it was not the best strategy. Returns are fundamental for the sustainable economic development (and, in the end, survival) of cooperatives, but, cooperatives have a higher social purpose. They are organizations of the social economy sector, their mission is to promote the members' welfare and, must of the times, it is contrary to profit maximization.

Therefore, we can expect that the variables coefficients present the signs showed in Table 6.

Table 6 – Variables Coefficients Expected Signs

Group 1 - Credit risk management ratios		Group 2 – Solvency ratios	
1. Transformation ratio	+	1. Liquidity	-
2. Credit overdue	+	2. Debt to Equity ratio	-/+
3. Credit overdue provision	-/+	3. Indebtedness	+
Group 3- Cost and expense ratios		**Group 4 – Return ratios**	
1. Labours costs	+	1. ROC	+/-
2. Other structural costs	+	2. ROA	+/-
3. Expenses ratio	-/+	3. Financial margin	+/-

5. Results

To determine which of the 12 explanatory variables presented in Table 3, are the best predictors of insolvency, following the same procedure of Janot (2001), a stepwise procedure combining forward and backward elimination is applied.

The model starts as a baseline model without any variable on it. The 12 indicators are considered one in each time and added to the model if succeeding in the selection criterion based on a p-value of 5% (Table B in annex). When a new variable is added to the model, the variables previously included are evaluated for exclusion, at 10% significance level. The ones who fail are excluded. When no more variables can be added or removed, the algorithm stops. The application of this approach provides the selection of only two indicators as relevant for the prediction of CCAM insolvency: Transformation Ratio (TR) and Other Structural Costs (OSC). Both indicators present a positive sign, as expected

But, before analyze the models results; we need to check the respect of the model assumption of proportional hazards. The Cox model assumes that the hazard function h(t) is directly related to the hazard baseline function, ho(t), as an *e* potency, represented in (6). Figure 1 is used to check this assumption. If the hazards are proportional, the Log Minus Log (LML) graphs need to be parallels. Since variables selected are continuous variables, they were transformed into dummy variables, assigning the value 1 to observations below the median and zero for observations above the median (Janot, 2001; Martins, 2003; Braga *et al.*, 2006). The graphs in Figure 1 show that Transformation Ratio (DumTR) and Other Structural Costs (DumOSCR) LML shapes. The graphs have sufficiently parallel shapes to confirm the proportional hazards hypothesis.

Figure 1- Log minus Log function of model variables

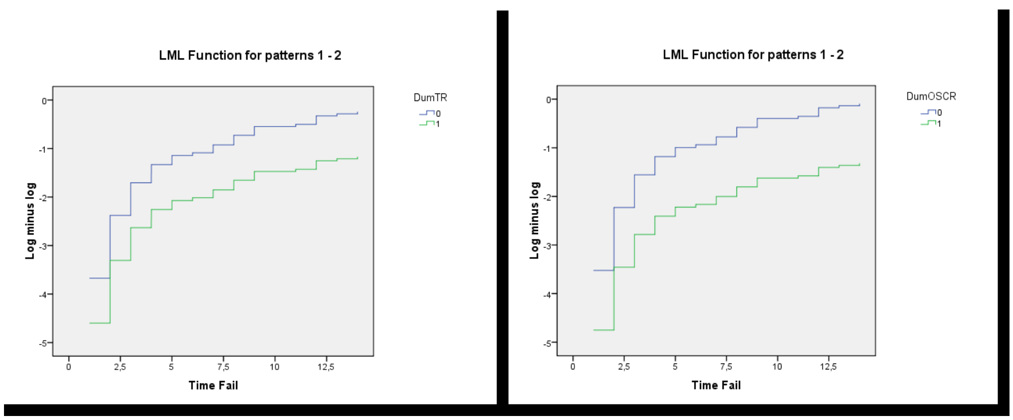


Figure 2 shows the Hazard and Survival Function of an “average” CCAM during the period of 1995-2009. As opposed to the survival function, the cumulative hazard function graphed presents insolvency probabilities after specific time periods.

The survival function, graphed in Figure 2, show that an average CCAM had a 98.4% of probability of solvency in year 1. Similarly to the results of others studies (Rocha, 1999; Janot, 2001; Fully-Bressan, 2002) that probability decreases over time, reaching 61% of probability of solvency through the year 14.

Figure 2 – Hazard and Survival Function at mean of covariates

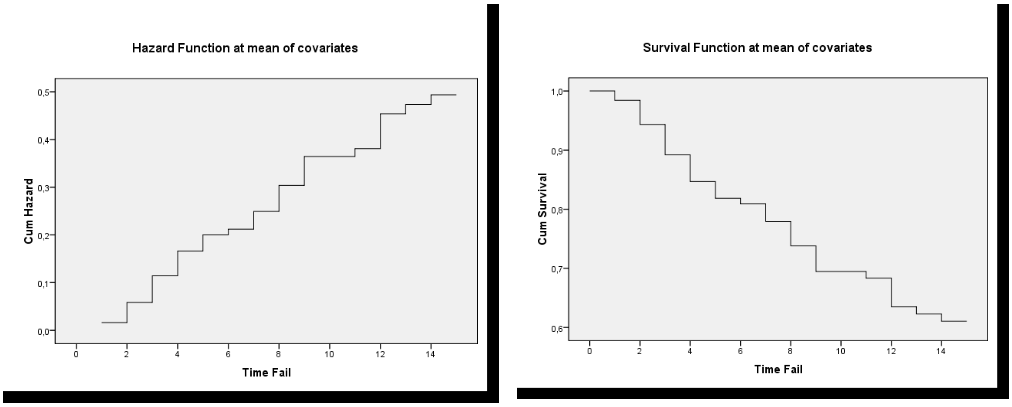


Table 6 presents estimation results from the selected model. The Table gives the estimate for each variable's coefficient, the standard error of this estimate, the probability level that the population coefficient is equal to zero, its relative hazard value and the confidence interval at 95% of probability.

In the model of Cox the coefficient β does not have direct interpretation. The analysis of it must be conjugated with remain values of the function of risk of the equation (6). Thus, what is evaluated is exponential of the coefficient β, represented in Table 6 by the relative hazard (RH). RH can be interpreted as the predicted change in the hazard for a unit increase in the predictor. Also, according to Braga *et al.* (2006), RH is a measure of the contribution of the individual variable to the predictive power of overall model.

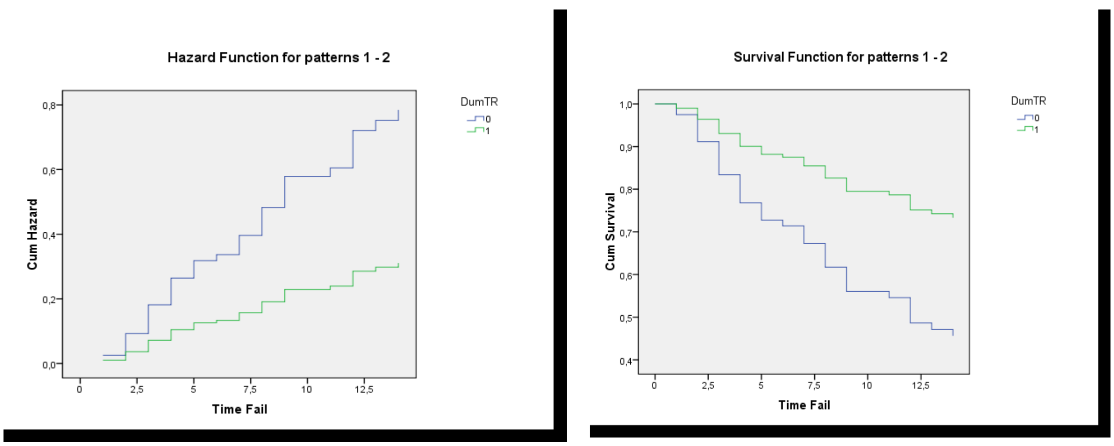
Table 6 – Cox Proportional hazards Model estimation results

Covariate	Coefficient (β)	Standard Error	p - value	Relative Hazard* (RH)	IC (RH, 95%)
Transformation ratio	0.926	0.350	0.008	2.525	(1.271; 5.017)
Other Structural costs	1.227	0.371	0.001	3.410	(1.647;7.057)

* RH=exp (β).

Transformation ratio is an indicator of the CCAM prudential lending policy. It showed to play an important role in the determination of CCAM insolvency. The positive sign of this indicator's β coefficient indicates that an increase in the Transformation ratio is associated with an increase in the probability of insolvency. The credit intermediation is the core business of banking activity; thus, CCAM main source of income lays on the differential between the interests paid to depositors and received from loaners. A high transformation ratio seeks to boost this source of income, increasing the volume of loans. It is a high return but high risk strategy, since it displays CCAM to liquidity pressure and to a potentially reckless lending practice. Additionally, CCAM with high transformation ratio are more vulnerable to negative variations in the economic conditions affecting the costumers' power to reimburse their loans and, thus, more open to credit overdue distress. The 2.525 RH means that the solvency hazards for a CCAM presenting a Transformation ratio above the median is 2.525 times that of a CCAM presenting a Transformation ratio bellow it. Additionally, we can state, with 95% of confidence that these risk lays between 1.271 and 5.017 (Table 6). As Figure 4 show higher Transformation ratio is associated with higher insolvency probability. Remember that the blue line (DumTR=0) represents the CCAM whose Transformation ratio is above the median, and the green line (DumTR=1) represents the CCAM whose Transformation ratio is below the median. The vertical distance between the lines represents the estimated reduction (increase) in survival (hazard) probability for the higher TR CCAM relative to the lower ones at every time horizon.

Figure 4 – Hazard and Survival Function for the covariate Transformation ratio



Historically, Crédito Agrícola presents the lowest transformation ratio of the Portuguese banking system; it never presented a value higher than 90%, with positive influence in CCAM liquidity. This cautious strategy[5] although negatively affecting CCAM profitability, showed to be, in the present scenario, the correct one. Indeed, with the entrance in euro, the Portuguese banking seek out, in international markets, for the funding needed to compensate the lack of internal savings. This took the transformation ratio of Portuguese banks to values far superior to 100%. With the current financial crisis and subsequent difficulties of gathering external

[5] Central CCAM recommends a Transformation ratio of 70% (Silva, 2008).

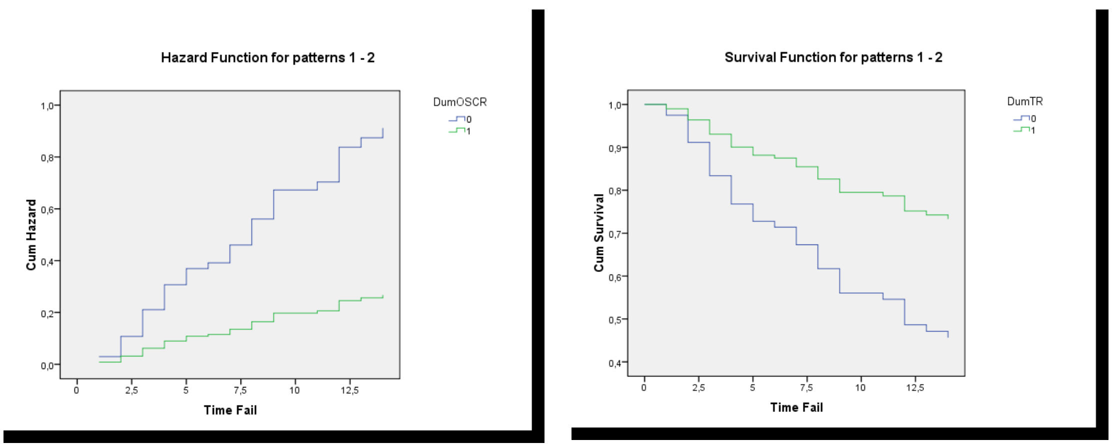
funding, this practice is no long successful and puts domestic banks under liquidity stress. CCAM minor transformation ratio has positive influence in CCAM liquidity. This gives Crédito Agrícola an exceptional liquidity situation in the domestic banking system, with a comfortable net interbank position (net credit on other banks), with a positive balance of 1.149 million euro (Credito Agrícola, 2009).

The other indicator found to be of use when forecasting solvency was Other Structural Costs, which is a measure of the CCAM cost efficiency, of its ability to explore scale economies and to rationalize the expenses from CCAM administrative and organizational structures. The 2.525 RH means that, as expected the results show that the solvency hazards for a CCAM presenting a ratio above the median is 3.410 times that of a CCAM presenting a ratio bellow it. And, we can state, with 95% of confidence that this risk lays between 1.647and 7.057.

By rule, the expenditures items must to be always under CCAM leaders' control. Banking is a highly competitive activity, were cost efficiency is crucial for success, thus, extreme expenditures will certainly result in financial problems.

Figure 5 bellow shows that higher Other Structural Costs (blue line) is associated with higher insolvency probability.

Figure 5 – Hazard and Survival Function for the covariate Other Structural Costs



6. Final remarks

SICAM double guardianship makes unusual to see a CCAM bankruptcy. In cases of coarse management failure or fraud, Central CCAM can dismiss CCAM management and supervising bodies and run the CCAM daily operations by appointing a provisory director to it. Long-term inefficiencies can be resolved through mergers with more efficient CCAM.

Additionally, CCAM deposits insurance fund also participates in CCAM rescuing operations granting subordinated loans to CCAM facing difficulties.

Although effective, all these mechanisms are post event answers, with high financial and social costs and, more important, do not help to prevent the insolvency event.

This paper offers a tool to understand CCAM risk of insolvency. The results show that the Cox Proportional Hazards Model is a helpful tool for the analysis of financial distress in CCAM, identifying variables that have a significant impact on CCAM solvency and describing the relationship between these explanatory variables and solvency. The results from Cox model indicate that Transformation ratio and Other Structural Costs are factors with a positive influence on CCAM insolvency. Specifically, CCAM presenting values for these indicators above median have a solvency hazard of approximately 6 (2.525+ 3.410) times that of a CCAM presenting a value bellow it.

The estimated model also generates the probability that a cooperative will survive longer than t time units, serving as an early warning, signing potential insolvent CCAM and providing the expected time to fail.

Given the values for a particular CCAM's explanatory variables, the Cox model can be used to predict (through calculation of the probability in (7)) if the CCAM will survive longer than *t* years. This is a task for further research. Additionally, also the evolution of CCAM relevant indicators of insolvency risk consequence of the natural development of banking activity and the changes in banking environment can be an interesting subject for future research.

Finally, the requirement of dummy variables to implement the Cox model diminishes its potential for revealing insolvency indicators. Several statistic measures and methods (median, mean, mode, ordinary least squares and maximum likelihood residuals, and so on) have been used to transform continuous variables in dummy variables but they are all *ad hoc* criterions. Without a supporting (economic, banking or management) theory behind it, this dichotomization can produce bizarre (and contrary to the expected) results, as in the Fully-Bressan (2002) study.

References

Altman, E. 1968. "Financial ratios, discriminant analysis and the prediction of corporation bankruptcy". *Journal of Finance*, 23(4), pp. 589-609.

Banco de Portugal. 2010. *Relatório de Supervisão Comportamental 2009. http://clientebancario.bportugal.pt/pt-PT/Publicacoes/RSC/Paginas/RSC.aspx*

Braga, M.; Fully Bressan, V., Colosimo, R. and Bressan, **A**. 2006. “Investigating the solvency of brazilian credit unions using a proportional hazard model”. *Annals of Public and Cooperative Economics*, 77 (1), pp. 83-106.

Cabo, P and Rebelo, J., 2005. “Why do Agricultural Credit Cooperatives Merge? The Portuguese Experience” *Annals of Public and Cooperative Economics*, 76 (3), pp. 491-516.

Crédito Agrícola, 2009. “Sustainability. Preliminary Report”. In *Crédito Agrícola Report and Consolidated Accounts 2008.* http://www.credito-agricola.pt/NR/rdonlyres/A9931DA6-B8B4-48B5-BB16-D6AD913EE170/0/SustainabilityPreliminaryReport.pdf

Colosimo, E. 2001. *Análise de sobrevivência aplicada.* Belo Horizonte: Departamento de Estatística da UFMG, 151 p.

Cox, D. 1972. “Regression models and life tables”. *Journal of the Royal Statistical Society*, 34(2), pp. 187-220.

Cox, D. and Oakes D. 1984. “Analysis Of Survival Data**”.** *Chapman and Hall*, London.

Dietrich, J. 1984. “Discussion of methodological issues relation to the estimation of financial distress prediction models”. *Journal of Accounting Research*, 2(6), pp. 83-86.

Emmery, D. and Finnerty J. 1997. Corporate financial management. Prentice Hall, 999p.

Fully-Bressan, V. 2002. *Análise de Insolvência das Cooperativas de Crédito Rural do Estado de Minas Gerais.* Universidade Federal de Viçosa, Viçosa, 102p.

Gimenes, K. 1998. *Análise do comportamento dos administradores financeiros com respeito ao custo e estrutura de capital aplicado às cooperativas agropecuárias do Estado do Paraná*. Universidade de León, 338 p

Janot, M. 2001. *Early Warning Models of Banking Failures in Brasil* **.** Banco Central do Brasil Working Paper #13.

Kanitz, S. 1978. *Como prever falências*. McGraw-Hill, São Paulo.

Lane, W., Looney, S. and Wansley, J. 1986. “An applications of the Cox Proportional Harzards model to bank failure”. ***Journal of Banking And Finance***, 10, pp. 511-531.

Lee, S. and Urritia, J.1986 “Analysis And Prediction Of Insolvency In The Property-Liability Insurance Industry: A Comparison Of Logit And Hazard Models”. *The Journal of Risk and Insurance*, 63(1) pp. 121-130.

Martins, M. 2003. A previsão de insolvência pelo modelo de Cox: uma contribuição para a análise de companhias abertas brasileiras. Universidade Federal do Rio Grande do Sul, Porto Alegre. 102p.

Matias A, and Siqueira, J. 1996.” Risco bancário: modelo de previsão de insolvência de bancos no Brasi”l. *Revista de Administração*, 31(2) pp. 19-28.

Rocha, F. 1999. “Previsão de falência bancária: um modelo de risco proporcional”. *Pesquisa e Planejamento Econômico,* 29(1), pp.. 137-152.

Silva, D. 2008. *Satisfação e Fidelização de Clientes: O Caso da Caixa de Crédito Agrícola Mútuo de Amares.* Universidade Fernando Pessoa, Porto. 156p.

Whalen, G. 1991. “A proportional hazards model of bank failure. An examination of its usefulness as an early warning tool”. *Economic Review*, Federal Reserve >Bank of Cleveland, First Quarter, p. 21-31.

Table A – Summary Statistics

All Sample

	# Cases	Mean	Median	Std. Deviation	Max	Min
Transformation ratio	92	0.567	0.571	0.171	1.299	0.226
Credit overdue	92	0.126	0.118	0.073	0.3025	0.000
Credit overdue provision	92	0.492	0.452	0.376	3.314	0.000
Liquidity	92	0.472	0.474	0.141	0.756	0.131
Debt to Equity ratio	92	35.981	20.947	68.058	587.806	2.683
Indebtedness	92	0.942	0.954	0.043	0.998	0.729
Labours costs	92	0.014	0.013	0.005	0.0334	0.005
Other structural costs	92	0.008	0.007	0.003	0.018	0.003
Expenses ratio	92	0.901	0.917	0.102	1.2723	0.606
ROC	92	0.576	0.302	1.092	7.738	-0.662
ROA	92	0.013	0.010	0.016	0.097	-0.031
Financial margin	92	0.043	0.040	0.013	0.097	0.009

Insolvent CCAM

	# Cases	Mean	Median	Std. Deviation	Max	Min
Transformation ratio	40	0.637	0.635	0.160	1.299	0.284
Credit overdue	40	0.131	0.146	0.078	0.296	0.000
Credit overdue provision	40	0.436	0.435	0.257	1.593	0.000
Liquidity	40	0.422	0.415	0.137	0.756	0.131
Debt to Equity ratio	40	34.983	24.043	34.515	175.559	5.584
Indebtedness	40	0.951	0.959	0.035	0.994	0.848
Labours costs	40	0.015	0.014	0.006	0.034	0.005
Other structural costs	40	0.009	0.009	0.003	0.018	0.004
Expenses ratio	40	0.892	0.898	0.126	1.273	0.606
ROC	40	0.870	0.394	1.565	7.738	-0.662
ROA	40	0.016	0.013	0.021	0.097	-0.031
Financial margin	40	0.048	0.044	0.015	0.097	0.020

Solvent CCAM

	# Cases	Mean	Median	Std. Deviation	Max	Min
Transformation ratio	52	0.513	0.489	0.161	0.940	0.226
Credit overdue	52	0.122	0.114	0.069	0.302	0.026
Credit overdue provision	52	0.535	0.467	0.444	3.314	0.082
Liquidity	52	0.511	0.507	0.133	0.748	0.269
Debt to Equity ratio	52	36.749	19.455	85.746	587.806	2.684
Indebtedness	52	0.935	0.951	0.047	0.998	0.729
Labours costs	52	0.013	0.012	0.004	0.023	0.005
Other structural costs	52	0.007	0.006	0.002	0.015	0.003
Expenses ratio	52	0.909	0.924	0.079	1.117	0.606
ROC	52	0.351	0.266	0.367	1.771	-0.241
ROA	52	0.011	0.009	0.011	0.064	-0.014
Financial margin	52	0.037	0.037	0.010	0.058	0.009

Table B – Summary results of covariates

	score	p-value
Credit Overdue	0.849	0.357
Transformation ratio	11.573	**0.001**
Credit Overdue Provision	0.845	0.381
Debt	0.858	0.354
Debt to Equity ratio	0.250	0.617
Return on Assets	0.154	0.695
Return on Shareholders Capital	1.733	0.188
Financial Margin	6.517	**0.011**
Labour Costs	1.984	0.154
Other Structural Costs	16.371	**0.000**
Expenses	0.154	0.695
Liquidity	11.394	**0.001**